A Coreless Type Linear Motor

BACKGROUND OF THE INVENTION

1. Field Of The Invention

Linear Motors can be classified into two types, core and coreless type, according to if the rotor has a core or not. The present invention relates to a coreless type linear motor, especially about the one having better heat dissipation effect.

2. Description Of The Prior Art

Rotors of commonly know linear motors are mainly composed of coils and epoxy resin; the front is used to provide the rotor with a variable magnetic field while the last is used to fasten coils. When electric current passes coils of the rotor, a magnetic field is produced and interworks with the magnetic field of the permanent magnet to generate thrust. The Manufacturing process of the rotor is to place the coils made of copper wires into the body of the plate-type rotor, and then to use epoxy resin and or other kinds of resin to fill and wrap around the whole coils to increase the strength of the rotor of the motor. Because quite part of energy due to electromagnetic interworking are transformed into heat energy, the temperature of the coil raises such that the electric resistance of the coils rises. In this way, the electric current value of the coils is lower down to decrease the efficacy of the rotor such that the maximum push thrust is restricted. In addition, variation of temperature also results in some problems, such as expansion and shrink of material, such that the assembly of the parts is too tight or too loose.

Commonly known methods for heat dissipation are classified into two following kinds: one is to set a coolant pipe into the rotor, and the other is to use the compressed air to carry heat of the rotor surface away (as US 5703418). Both methods described above have obvious disadvantages: the former requires to set the coolant pipe into the limited room of the rotor, so the mechanism is more complicated, the manufacturing cost is higher, the volume and weight of the rotor are added, and an extra mechanism is essential to guide the flow of liquid for heat dissipation such that it is not economic; the last method is to use the compressed air to cool the surface of the rotor, and comparing with the former method, it is simpler in mechanism, but worse in the effect of heat dissipation due to that the heat conductivity of the closed structure used for wrapping coils is poor to make temperature difference between the surface of the rotor and the nearby area of the coils large.

Therefore, the methods for heat dissipation are a big problem for designing a linear motor.

SUMMARY OF THE INVENTION

The purpose of the present invention is to solve the disadvantages, such as poor heat dissipation ability, complicated heat dissipation mechanism and high manufacturing cost, of the coreless type linear motor using common known technologies described above. Besides, the present invention also avoids the condition that the assembly of parts is too tight or too loose, or the efficacy of the motor lowers due to raise of temperature after the linear motor is used for a period.

The consideration for the method of heat dissipation in the present invention is first to avoid using a coolant pipe to avoid having many pipes in the rotor of the linear motor and adding many complicated mechanisms to make the coolant flow. Then,

for enhancing the effect of heat dissipation, the heat resistance of the heat source and the external requires to be lowered. In order to achieve the requirement, the coils of the rotor are not designed as winding type to gather the winded coils. Although this may increase the volume slightly, heat generation is more centered such that it is easy and convenient to make the heat dissipate to the air by trenching some holes at the center of the coils or the area around the coils to make the holes interlink to external air. The method not only adds the contact area between the coils of the rotor of the motor and air, but also adds the effect of heat dissipation of coils due to avoiding that the insulating substance isolates thermal conduction. Besides, the weight of the rotor is reduced and the effective thrust of the linear motor is risen due to part of material is reduced.

Because the coils of the rotor provide the motive force of the linear motor and also suffer from counterforce, heat sink compound with good thermal conductivity is smeared around the coils for the sake of protecting the coils. The heat sink compound can improve the thermal conductivity between the coils and the material around the coils. For the sake of further promoting the heat dissipation effect of the rotor, heat sink compound is smeared around the heat dissipation holes to enlarge the heat dissipation area. In this way, when the rotor of the motor moves, flowing air around the rotor can efficiently carry the heat of the surface of the heat sink compound away.

Some mechanisms require rotors having structure with higher strength, so heat sink compound can be filled up the heat holes. Besides, the rotor can has better effect of heat dissipation, and have better structure strength. In order to promote heat dissipation effect between the heat sink compound and air, ragged strips are set at the contacting surface between the heat sink compound and air to increase heat

dissipation effect.

In the other hand, if the heat pipe is fastened by heat sink compound and buried into the heat hole. One end of the heat pipe is buried near a coil while the other end is extended to the outside of the closed structure of the coils, so heat of the coils can be conducted easily to the outside of the closed structure of the coils via the heat pipes such that heat can be conducted to air efficiently through the heat pipes. The heat pipe is usually made of metal having good thermal conductivity to make heat can be conducted along the heat pipe. For some airtight hallow heat pipes, the interior is designed to be almost a vacuum, and have very good thermal conductivity. In order to make thermal conduction effect better, the end, which is at the exterior of the closed structure of the coils, of the heat pipe can be connected with a heat sink, which are usually made of metal, and can help to transfer heat to air.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings disclose an illustrative embodiment of the present invention which serves to exemplify the various advantages and objects hereof, and are as follows:

FIG.1 3D partial cutaway view of one practice sample the present invention

FIG.2 3D partial cutaway view of another practice sample of the present invention

FIG.3 3D partial cutaway view of the practice sample of the additional heat pipe of the present invention

DETAILED DECRIPTION OF THE PREFERRED EMBODIMENT

FIG.1 is the 3D partial cutaway view of one practice sample the present invention, wherein the linear motor contains a rotor 1 and a stator 2, and the stator 2 is U-type, and the rotor 1 can slide in the U-type structure. The stator 2 is composed of

two guide plates 22, 23, several plates of permanent magnets 21 and a stator bottom plate 24. The guide plates are made of ferromagnetic material, which usually is pure iron to reduce hysteresis. Several plates of permanent magnets 21 are pasted on the top surface of the guide plate 22 and the bottom surface of the guide plate 23. The stator bottom plate 24 is set at the middle of the guide plates 22 and 23 having permanent magnets 21 and holds them to make the whole structure as a U-shape structure. After the structure is assembled, the permanent magnet 21 is at the middle of guide plates 22, 23, and neighbors with the rotor 1. The rotor 1 is made as plate form, and composed of a rotor base 15, upper cover 13, bottom cover 11, coils 12 and heat sink compound 14. Coil troughs 111 are set on the bottom cover 11, and coils 12 are placed into the coil troughs 111. Heat holes 131 are set at the upper cover 13. After the upper cover 13 and the bottom cover 11 are assembled, heat sink compound 14 is smeared over the heat holes 131 and the coil troughs 111 to keep the stability of the coils 12.

In the practice sample, the heat holes 131 are set near the coils 12 of the rotor 1, and the heat sink compound 14 in the heat holes 131 has good thermal conduction effect, and, besides, the heat sink compound 14 can contact air directly because of setting heat holes 131, so heat produced by the coils 12 can be conducted to the surface of the rotor 1 directly via the heat sink compound 14 of the heat holes 131, and then heat is easily carried away by the flowing air as the rotor 1 is moving and not isolated by the upper cover 13 or other components of the rotor 1. The structure is simple and volume is not be added such that the economic value is risen.

Otherwise, except for that weight of the rotor is reduced because that the heat holes 131 are set on the rotor 1, the heat sink compound 14 is only smeared on the surface of the coil wall 121 such that the weight pf the rotor 1 is lighter than

commonly known linear motors, and inertial of the rotor is reduced while effective thrust of the rotor is increased. In the figure, heat dissipation holes 132 are set near the coils 12 to increase heat dissipation effect of the rotor. In order to avoid reducing the strength of the rotor 1, heat sink compound can be filled into the heat dissipation holes 132. Thermal conduction effect of heat sink compound is quietly better than epoxy resin and make the rotor have good strength.

FIG.2 is the 3D partial cutaway view of another practice sample of the present invention, wherein main difference of the linear motor from FIG.1 is that heat sink compound is filled into the heat holes 131 of the rotor 1. The heat holes 131 filled with the heat sink compound 14 increase the weight of the rotor 1, and the material cost. However, comparing with commonly known technologies, the weight of the practice sample of the rotor in FIG.2 is not heavier than commonly known technologies. Besides, the heat sink compound 14 extends to the surface of the upper cover 13 and the bottom cover 11, so heat dissipation effect is much better than commonly known technologies. In addition, the heat holes 131 of the rotor is filled with the heat sink compound 14 which has similar strength of the resin, so the rotor has both good structure strength and heat dissipation effect.

FIG.3 is the 3D partial cutaway view of the practice sample of the additional heat, heat pipes 16 are set into the heat holes 131 of the rotor 1, and a heat sink 17 is set at another end of the heat pipes 16. The heat pipes 16 serve as the media of conducting heat of the coils 12 to the heat sinks 17, and increase strength of the rotor 1. The heat sink compound 14 is smeared between the coils 12 and the heat pipes 16 to increase the contact area and thermal conduction efficacy between the coils 12 and the heat pipes 16. In the practice sample of the FIG.3, because the heat pipes 16 are close to the heating coils 12, the heat pipes 16 provide a path for heat conduction to

make heat pass through insulating substance via the heat pipe 16 to make heat be conducted to the heat sink 17, and the heat sink 17 can increase the speed of heat dissipating to air to increase the efficacy of heat dissipation. Because the heat pipes 16 are set in the heat holes 131, it is not like the commonly know technologies that the thickness and the length of the rotor 1 are be increased due to adding enforced cooling mechanism such that the extra weight is increased.

Many changes and modifications in the above described embodiment of the invention can, of course, be carried out without departing from the scope thereof. Accordingly, to promote the progress in science and the useful arts, the invention is disclosed and is intended to be limited only by the scope of the appended claims.